The Effect of Quadriceps Strength on Abnormal Movement Patterns After ACL Reconstruction: A Systematic Review

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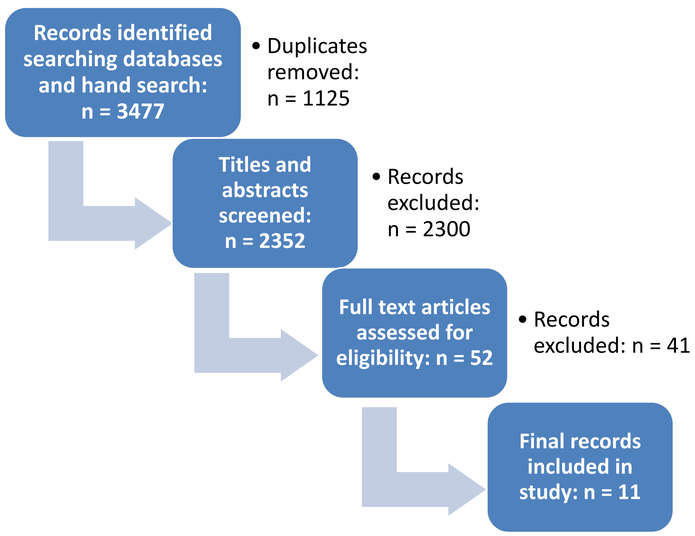
Introduction and Background

The anterior cruciate ligament (ACL) is a ligament in the knee that is at risk for tearing in cutting movements. Approximately 200,000 tears occur annually with 90% of them resulting in ACL reconstruction (ACLR) in the US.[1] ACLR yields variable outcomes, with as few as 50% of patients returning to pre-injury levels of activity within 12 months after ACLR,[2] and as many as 30% of patients suffering a second ACLR injury within 2 years after return to sport (RTS).[3] The mechanism underlying this variation in outcome remains unknown. Quadriceps femoris strength deficits after ACLR can persist up to 24 months after surgery and may lead to abnormal function.[4] There is a lack of understanding of the relationship between quadriceps femoris strength and high-risk movement patterns after ACLR, known to predict future ACL injury risk. Identification of the relationship between these factors may lead to new strategies to improve patient outcome and decrease risk of second ACL injuries.

Purpose Statement

The purpose of this systematic review is to describe and critically evaluate the evidence surrounding the relationship between quadriceps femoris strength and specific altered dynamic movement patterns in patients after ACLR.

Literature Search



Methods

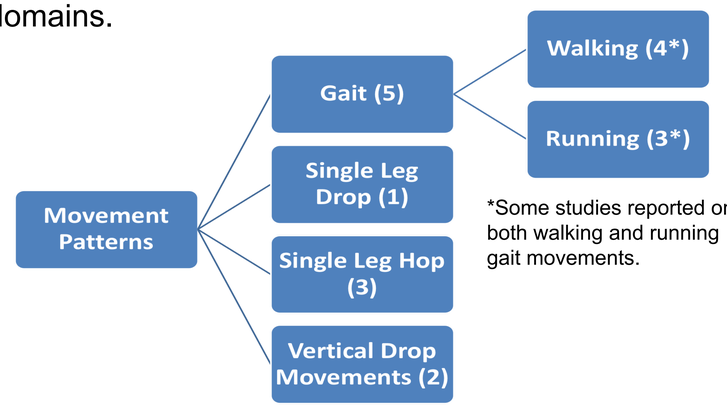
After conducting the literature search, 2352 articles were screened by 2 reviewers according to predetermined inclusion and exclusion criteria. The 11 articles selected for this review then underwent a quality assessment test. Next, the articles were reviewed and data was extracted according to the purpose of this review.

Strength Assessments

Isokinetic and isometric dynamometry were the primary assessment tools used to determine quadriceps femoris strength

Movement Pattern Assessments

Various movement patterns were assessed in the literature and were categorized into the following domains.



Results

- Gait Movements:
  - Walking: Contradictory results for relationship between quadriceps strength and kinematics and kinetics
  - Running: Consistent significant relationship reported – decrease in external flexion moment and straighter leg in running gait has been significantly correlated to quadriceps strength
- Single Leg Drop Movement: Quadriceps strength significantly predicted knee flexion excursion and peak internal knee extension moment, which are observed to be lower in involved leg

Results (cont'd)

- Single Leg Hop Movements: Mixed results reported in the literature with the majority identifying a positive correlation with greater quadriceps strength and increased external knee flexor moment while landing
- Drop Vertical Movements: Quadriceps strength was found to be a predictor of asymmetries during the drop vertical movements with increased strength relating to decreased errors, increased external knee flexion moments and peak vertical ground reaction force

Conclusion

Overall, these studies suggest a strong relationship between quadriceps strength deficits and abnormal movement patterns, with an increase in strength leading to an improved technique or decrease in asymmetries. Clinically, this presents in patients who have weaker quadriceps, displaying a straighter knee in their movements. However, the literature does present some variability in the results, particularly among less demanding dynamic movement patterns, like walking gait, and the horizontal hop test. This research is limited to only the role of the quadriceps, and it should be expanded to other factors, such as knee flexor and hip extensor strength. The results of this review paper and future work looking at the relationships of other factors to abnormal movement patterns will provide clinicians with critical information, necessary to improve rehabilitation protocols and improve patient outcomes.

Key References

[1] Linko E, Harilainen A, Malmivaara A, Seitsalo S. Surgical versus conservative interventions for anterior cruciate ligament ruptures in adults. *Cochrane Database Syst Rev.* 2005(2):CD001356.

[2] Ardern CL, Taylor NF, Feller JA, Webster KE. Return-to-sport outcomes at 2 to 7 years after anterior cruciate ligament reconstruction surgery. American Journal of Sports Medicine. 2012;40(1):41-4

[3] Paterno MV, Rauh MJ, Schmitt LC, Ford KR, Hewett TE. Incidence of second ACL injuries 2 years after primary ACL reconstruction and return to sport. Am J Sports Med. 2014;42(7):1567-1573.

[4] Mattacola, C. G., Perrin, D. H., Gansneder, B. M., Gieck, J. H., Saliba, E. N., & McCue, F. C. (2002). Strength, Functional Outcome, and Postural Stability After Anterior Cruciate Ligament Reconstruction. *Journal of Athletic Training*, *37*(3), 262–268.

Headlines: 88pt Bold

Body Text: 72pt

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